A METHOD AND A DEVICE FOR OPERATING VOICE-CONTROLLED SYSTEMS IN MOTOR VEHICLES

FIELD OF THE INVENTION

The present invention relates to a method and a device, ~~according to the definition of the species in Claims 1 and 5~~, for operating voice-controlled systems, such as communication and/or one-way/two-way intercom devices in motor vehicles, where voice signals are picked up by a multiple microphone system and transmitted to at least one loudspeaker.

BACKGROUND INFORMATION

On the one hand, methods of this type are used in motor vehicles for voice-controlled intercom operation, but they are also used for supporting voice-input controlled electronic or electric modules. In this case, the fundamental problem is that, depending on the operating state, corresponding background noise is present in the motor vehicle. This background noise masks the voice commands. One- and two-way intercom systems in motor vehicles are ~~predominantly~~ advantageous in large vehicles, minibusses, and the like. However, they can also be used in normal passenger cars. Suppressing background noise or filtering out the voice command is still very important in the use of voice-controlled input units for electric components in the vehicle.

A ~~Along these lines, a~~ voice-recognition device for a motor vehicle is described, for example, in European Patent No. 0 078 014 ~~known from EP 0078014 B 1~~, where sensors signal or feed into the amplifier system of the voice-recognition device, whether or not the engine is running and/or the vehicle is moving. This device ~~then~~ guides a level control, by ~~means of~~ which it is attempted to isolate the voice command from the background noise.

German Patent No. 37 42 929 ~~DE 3742929 C1~~ describes a ~~set-up~~ system having two microphones, one of the microphones being disposed at the mouth of the operator, and another in proximity, which is, however, for picking up the structure-borne noise. Both microphone signals are triggered ~~in such manner~~ so, that structure-borne noise can be subtracted from the total noise.

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German Published Patent Application No. 19705 471 describes ~~From DE 197 05 471 A1,~~ it is known to support a voice-recognition system using transverse filtering. In this case, a frequency analysis is performed ~~undertaken~~, which is only used for the purpose of recognizing speech commands. No ambient-noise compensation is performed ~~takes place here~~.

Filtering is described in International Patent Publication No. ~~known from~~ WO 97/34290, in which ~~where~~ periodic interference signals are filtered out by ascertaining their periods and canceling them out by interference, using a generator, so that the voice signal remains.

German Patent No. 41 06 405 ~~DE 41 06 405 C2~~ describes a method in which noise is subtracted from the voice signal, a plurality of microphones being used.

The use of a multiple microphone array is described in German Published Patent Application No. 39 25 589 ~~known from DE 39 25 589 A1~~. When using array ~~it~~ in the motor vehicle, one of the microphones is disposed in the engine compartment and another microphone is disposed in the passenger compartment. Both signals are then subtracted. A disadvantage in this case, is that only the engine noise, i.e., ~~i. e.~~ the actual operational noise of the vehicle itself, is subtracted from the total signal in the passenger compartment. Specific ambient noises are not, however, considered ~~left out of consideration here~~. The ~~In the same way, the~~ lack of feedback suppression presents a special problem. Wherever microphones and loudspeakers are arranged in acoustically coupleable proximity, the acoustic signal decoupled at the loudspeaker is fed back into the microphone ~~again.~~ This results in so-called feedback and a subsequent overload.

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A similar method is known from DE 39 25 589 A1, where a composite signal made of a voice signal and an external signal is formed. The additional picking-up of external noise takes place separately. The external-noise and voice signals are lead over a filter and are subtracted from the composite signal. Then, the result of the comparison controls the filter. A method of this type cannot effectively prevent the ~~occurrence of echos and feedback.~~

Therefore, it is an object of ~~the present invention is based on the object of further developing a~~ to provide for operating voice-controlled systems in motor vehicles ~~method and a device of the species, to the effect~~ that instances of feedback and instability occurring ~~in a system of multiple~~ microphones ~~and loudspeakers~~ are suppressed.

~~The stated object of the present invention is achieved in a method of the species, by the characterizing features of Claim 1.~~

~~Advantageous further refinements of the method are specified in Claims 2 through 4.~~

Summary

Regarding a device of the species, the stated object of the present invention is achieved by the characterizing features of Claims 5. Advantageous further refinements of the device according to the present invention are specified in the remaining claims.

With regard to both the method and the device, the present invention ~~starts out from~~ is based on a communication and/or one-way/two-way intercom device in motor vehicles. ~~To this end, it is also known to set up a~~ A multiple microphone system is provided, to ~~also~~ pick up both voice and noise signals. ~~and to subtract the noi~~ Noise signals are subtracted ~~again~~ from the total signal, so that the filtered voice signal remains.

~~According to the stated object, the essence of the~~ The present invention ~~consists~~ includes in initially shifting the frequency of the specific microphone signal by a small amount Δ F, and only then transmitting the microphone signal to the loudspeaker(s) or to the input of a voice-controlled device. The frequency shift of the present invention, which is ~~undertaken~~ performed at a defined position and is not arbitrary, supports the filtering on the one hand, and decouples feedback, and therefore the echo signal, on the

InsA2 other hand, A2 by subtracting the composite signal shifted by Δ F, of another, i.e. second, microphone, from the composite signal of a first microphone, whose frequency is not yet shifted; and vice versa.

Since, without the aforesaid frequency shift of the present invention, feedback is nothing more than the fed-back, amplified voice signal, such feedback cannot be eliminated by ~~means~~ conventional systems and procedures from the cited related art. This is therefore the case, because conventional devices ~~of the related art~~ only separate the voice signal from the noise signal, and identify the fed-back signal as a voice signal, and not as a noise signal. For this reason, the aforesaid instances of feedback cannot be controlled by the ~~means known in the related art, or~~ conventional systems and methods and cannot be controlled simultaneously.

In contrast, the method and the device of the present invention, the latter of which relates to the connection of the individual elements to one another, eliminate feedback effects in ~~an elegant~~ simple and efficient manner.

Since feedback, ~~as such~~, always occurs when the microphone and loudspeaker locations are close together, as ~~is compulsory~~ generally occurs in motor vehicles, the elimination of this feedback is very important ~~in the mentioned application case~~. This is not only valid in the case of intercom operation, where electroacoustical feedback is uncomfortable for the passengers, but it also has special significance in the use of voice-controlled input interfaces of electrical or electronic components on the vehicle. This only applies when the entire system in the vehicle includes both microphones and loudspeakers, and in this case, also when the input to electrical devices is voice-controlled. Feedback and resulting overloads can cause considerable malfunctions and misinterpretations of the voice command, even in the case of intelligent input interfaces. Depending on the application ~~case,~~ this also constitutes a safety hazard. As an option, noise reduction can also be implemented at the same time, ~~i.e.~~ i.e., simultaneously.

The present invention is represented in the drawing, and subsequently described in detail.

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~~The figure shows the principal design, as well as the functioning method, so that both the method steps and the connection of the individual elements of the present invention to each other can be seen in their logical entirety, from the figure itself.~~

In ~~this displayed~~ the illustrated exemplary embodiment of the present invention, the vehicle interior is subdivided into two subspaces, namely front and rear.

A microphone M 1 and a loudspeaker L 2 are located in the front section. Microphone M 1 picks up the voice signal ~~there~~, and possibly picks up noise signals as well. In this case, the noise signal is made up of the background noise in the passenger compartment, which occurs while operating the vehicle. This ~~can be~~ engine noises, wind noises, ~~as well as~~ rolling noises, but also acoustical echo signals from the other subspace, and the like. The composite signal (total signal)

(total signal) detected may include

~~contained~~ at M 1, which ~~is made up~~ of background speech and background noise, is fed to a first summation point S 1. Then, a correspondingly conditioned signal from an acoustic model AM 1 in front is also fed to this summation point. In this exemplary embodiment, the subtraction signal generated in acoustic model AM 1 originates from the signal, which is obtained in the rear section of the vehicle, and is already shifted in frequency. Because this signal, which comes from M 2, is frequency-shifted in F2, and originates from the rear subspace of the passenger compartment, is also taken into account in front on a signal basis, by AM 1, the signal, which is generated in the rear subspace of the vehicle, is acoustically transported up front, into the front subspace of the passenger compartment, and is also registered by M 1, is subtracted again at summation point S 1. Thus, ~~This means that~~ the rear subspace of the passenger compartment is acoustically separated from the front subspace of the passenger compartment by device AM 1. That is, the total detectable acoustical signal is initially fed into M 1, and the echo from the rear subspace of the passenger compartment is initially subtracted at summation point S 1. The original signal from the front subspace of the passenger compartment, which is obtained from M 1 in this manner, is then supplied to a frequency-shifting device F 1, and shifted by an amount Δ F, e.g. 5 Hz. The F 1 output signal obtained in this manner is then supplied to loudspeaker L 1 of the rear passenger-compartment subspace and, on the other hand, is simultaneously fed into device AM 2 in the same manner. In this case, AM 2 again represents the acoustic model for the rear subspace of the passenger compartment. A voice message is transmitted in an analogous manner from the rear subspace of the passenger compartment, via M2, to the front subspace of the passenger compartment, via L 2. That is, microphone M 2 registers the voice message together with the background noise in the rear subspace of the passenger compartment, and transmits them to summation point S 2, in ~~at~~ which the total acoustical signal picked up by M1, i.e., the echo as well as ambient noises, is subtracted. In turn, the echo-free signal from microphone M 2, which is generated in this manner, is then supplied to a frequency-shifting device F 2, as well, which again shifts the frequency by an amount Δ F. At the output of this frequency-shifting device F 2, the result, i.e., the signal conditioned in this manner, is again supplied to the front subspace of the passenger compartment, namely to loudspeaker L 2 positioned there. The frequency shift for the transmission from the

front to the rear can also be different from the frequency shift from the rear to the front.

All in all, the result is a closed, feedback-free system. The shifting of the frequency is an important feature here, and the echo from the front to the rear subspace, and vice versa, is eliminated by the interaction with the connection via acoustic models AM 1 and AM 2.

However, it is also possible to add a noise-signal subtraction to the echo suppression and feedback elimination. This can also be appropriately taken into consideration in the specific acoustic model AM 1 and AM 2. The additional components necessary for this purpose, such as noise-signal microphones, are not shown here in further detail.

Therefore, it ~~can be said that the to~~tal ~~background-noise signal made up of echo and other noises is subtracted~~ was from every acoustical input signal from M 1 and M 2, before it is processed further and fed to loudspeakers L 2 and L 1, respectively. So not only does an acoustic decoupling ~~take place~~ occur between the front and rear subspaces of the passenger compartment, but also the remaining noise signals are quasi compensated for, or subtracted, in ~~one~~ and the same ~~action~~ step.